WHAT IS CLAIMED IS:

1. An electron-emitting device comprising:

an electron source layer made of one of a metal, a metal alloy and a semiconductor;

an insulating layer formed on said electron source layer, said insulating layer having at least one island region serving as an electron-emitting section in which film thickness of said insulating layer is gradually reduced;

a carbon region made of one of carbon and a carbon compound provided on at least one of top, bottom and inside of said island region; and

a metal thin film electrode formed on said insulating layer, wherein electrons are emitted upon application of an electric field between said electron source layer and said metal thin film electrode.

2. An electron-emitting device as claimed in claim 1 wherein said metal thin film electrode and said carbon region are deposited by one of a physical deposition method and a chemical deposition method.

3. An electron-emitting device as claimed in claim 1 wherein said carbon region is a thin film deposited on one of said island region and said metal thin film electrode.

4. An electron-emitting device as claimed in claim 1 wherein said carbon region is a thin film deposited on said

island region while a voltage is being applied between said electron source layer and said metal thin film electrode.

5. An electron-emitting device as claimed in claim 4 wherein said applied voltage is supplied intermittently according to a voltage application period in which the voltage rises and falls.

6. An electron-emitting device as claimed in claim 1 wherein said carbon region is distributed within said metal thin film electrode.

7. An electron-emitting device as claimed in claim 1 wherein said carbon region is a thin film deposited under said metal thin film electrode.

8. An electron-emitting device as claimed in claim 1 wherein said carbon region is a thin film deposited under said insulating layer.

9. An electron-emitting device as claimed in claim 1 wherein the thickness of said metal thin film is gradually reduced in conjunction with said insulating layer.

10. An electron-emitting device as claimed in claim 1 wherein the thickness of said carbon region is gradually reduced in conjunction with said insulating layer.

11. An electron-emitting device as claimed in claim 1 wherein said insulating layer is made of a dielectric material and has a thickness of at least 50 nm in areas other than said island region.

12. An electron-emitting device as claimed in claim 1 wherein said metal thin film electrode terminates on said insulating layer within said island region.

13. An electron-emitting device as claimed in claim 1 wherein said insulating layer terminates on said electron source layer within said island region.

14. An electron-emitting device as claimed in claim 1 wherein said island region is a recess on a flat surface of said metal thin film electrode and said insulating layer.

15. An electron-emitting device as claimed in claim 1 further comprising a fine particle within said island region.

16. An electron-emitting device as claimed in claim 1 further comprising, within said island region, a reverse-tapered block projecting in a direction normal to said substrate and at a top portion thereof, includes an overhang projecting in a direction parallel to said substrate.

17. A method for manufacturing an electron-emitting device comprising:

an electron source layer formation process for forming an electron source layer made of one of a metal, a metal alloy and a semiconductor on a substrate;

a mask formation process for forming masks on said electron source layer, each of said masks providing a shade around an area in which the masks contact with said electron source layer;

an insulating layer formation process for depositing an insulating layer over said electron source layer and said masks so as to provide said insulating layer as a thin film of an insulator, said insulating layer having island regions in which film thickness of said insulating layer is gradually reduced in the proximity of the contact areas of said masks; and

a metal thin film electrode formation process for forming a metal thin film electrode over said insulating layer, thereby constituting said island regions as electron-emitting sections;

said manufacturing method further comprising a process for providing a carbon region made of one of carbon and a carbon compound proximal to said island regions.

18. A manufacturing method as claimed in claim 17 further comprising a mask elimination process for eliminating said masks immediately after said metal thin film electrode formation process, and said process for providing said carbon region is performed immediately after said mask elimination process, thereby forming said carbon region as a thin film deposited over said metal thin film electrode.

19. A manufacturing method as claimed in claim 18 wherein said process for providing said carbon region is performed by depositing said carbon region as a thin film while applying a voltage between said electron source layer and said metal thin film electrode.

20. A manufacturing method as claimed in claim 19 wherein said applied voltage is supplied intermittently according to a voltage application period in which the voltage rises and falls.

21. A manufacturing method as claimed in claim 17 further comprising a mask elimination process for eliminating said masks immediately after said insulating layer formation process, and said process for providing said carbon region is performed during said metal thin film electrode formation process, thereby having said carbon region distributed within said metal thin film electrode.

22. A manufacturing method as claimed in claim 17 wherein said process for providing said carbon region is performed immediately after said metal thin film electrode formation process, thereby forming said carbon region as a thin film deposited over said metal thin film electrode.

23. A manufacturing method as claimed in claim 17 wherein said process for providing said carbon region is performed immediately before said metal thin film electrode formation process, thereby forming said carbon region as a thin film deposited under said metal thin film electrode.

24. A manufacturing method as claimed in claim 17 wherein said process for providing said carbon region is performed immediately before said insulating layer formation process, thereby forming said carbon region as a thin film deposited

under said insulating layer.

25. A manufacturing method as claimed in claim 22 further comprising a mask elimination process for eliminating said masks immediately after said metal thin film electrode formation process, and said process for providing said carbon region is performed immediately after said mask elimination process, thereby forming said carbon region as a thin film deposited over said metal thin film electrode.

26. A manufacturing method as claimed in claim 17 wherein a voltage is applied between said electron source layer and said metal thin film electrode immediately after at least one of said process for providing said carbon region, said metal thin film electrode formation process, and said mask elimination process.

27. A manufacturing method as claimed in claim 17 wherein said masks are fine particles, and said mask formation process comprises a step of spraying said fine particles onto said electron source layer.

28. A manufacturing method as claimed in claim 17 wherein each of said masks is an electrically insulating reverse-tapered block which projects outwardly in a direction normal to said substrate and has an overhang in a top portion thereof, projecting in a direction parallel to said substrate, and said mask formation process includes steps of:

forming a reverse-tapered block material layer on said

substrate;

forming thereon a resist mask which allows at least a part of said electron source layer to be exposed through a photolithographic method; and

etching out said reverse-tapered block having said overhang by one of a dry etching method and a wet etching method.

29. A manufacturing method as claimed in claim 17 wherein said insulating layer, said metal thin film electrode and said carbon region are deposited by a physical deposition method or a chemical deposition method.

30. A display apparatus comprising;

a first substrate and a second substrate facing each other with a vacuum space therebetween;

a plurality of electron-emitting devices provided on said first substrate;

a collector electrode provided on an interior surface of said second substrate; and

a phosphor layer formed on said collector electrode; wherein each of said electron-emitting devices comprises an electron source layer made of one of a metal, a metal alloy and a semiconductor formed on an ohmic electrode, an insulating layer formed on said electron source layer and a metal thin film electrode formed on said insulating layer, said insulating layer having at least one island region constituting an electron-emitting section in which the film thickness of said

insulating layer is gradually reduced, and a carbon region made of one of carbon and a carbon compound is provided on at least one of a top, bottom and inside of said island region.

31. A display apparatus as claimed in claim 30 wherein said insulating layer, said metal thin film electrode and said carbon region are deposited by one of a physical deposition method and a chemical deposition method.

32. A display apparatus as claimed in claim 30 wherein said carbon region is a thin film deposited on one of said island region and said metal thin film electrode.

33. A display apparatus as claimed in claim 30 wherein said carbon region is a thin film deposited on said island region while a voltage is being applied between said electron source layer and said metal thin film electrode.

34. A display apparatus as claimed in claim 30 wherein said applied voltage is supplied intermittently according to a voltage application period in which the voltage rises and falls.

35. A display apparatus as claimed in claim 30 wherein said carbon region is distributed within said metal thin film electrode.

36. A display apparatus as claimed in claim 30 wherein said carbon region is a thin film deposited under said metal thin film electrode.

37. A display apparatus as claimed in claim 30 wherein

said carbon region is a thin film deposited under said insulating layer.

38. A display apparatus as claimed in claim 30 wherein the thickness of said metal thin film electrode is gradually reduced in conjunction with said insulating layer.

39. A display apparatus as claimed in claim 30 wherein the thickness of said carbon region is gradually reduced in conduction with said insulating layer.

40. A display apparatus as claimed in claim 30 wherein said insulating layer is made of a dielectric material and has a film thickness of at least 50 nm in areas other than said island region.

41. A display apparatus as claimed in claim 30 wherein said metal thin film electrode terminates on said insulating layer within said island region.

42. A display apparatus as claimed in claim 30 wherein said insulating layer terminates on said electron source layer within said island region.

43. A display apparatus as claimed in claim 30 wherein said island region is a recess on a flat surface of said metal thin film electrode and said insulating layer.

44. A display apparatus as claimed in claim 30 further comprising a fine particle within said island region.

45. A display apparatus as claimed in claim 30 further comprising, within said island region, a reverse-tapered block

which projects outwardly in a direction normal to said substrate and has an overhang in a top portion thereof, projecting in a direction parallel to said substrate.

46. A display apparatus as claimed in claim 30 wherein bus lines are formed over a plurality of said metal thin film electrodes, and said ohmic electrodes and said bus lines are electrodes, each having a shape of a strip, and arranged orthogonal to each other.

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